

US010000581B2

(12) United States Patent

Thompson et al.

(10) Patent No.: US 10,000,581 B2

(45) **Date of Patent: Jun. 19, 2018**

(54) THERAPEUTIC AND IMAGING COMPOSITIONS AND USES THEREOF

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(*) Notice: Subject to any disclaimer, the term of this

patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days. days.

(21) Appl. No.: 14/889,722

(22) PCT Filed: May 7, 2014

(86) PCT No.: PCT/US2014/037134

§ 371 (c)(1),

(2) Date: Nov. 6, 2015

(87) PCT Pub. No.: WO2014/182804

PCT Pub. Date: Nov. 13, 2014

(65) Prior Publication Data

US 2016/0083485 A1 Mar. 24, 2016

Related U.S. Application Data

- (60) Provisional application No. 61/820,658, filed on May 7, 2013, provisional application No. 61/820,597, filed on May 7, 2013.
- (51) **Int. Cl.** A61K 8/00 (2006.01)C08B 37/16 (2006.01)G01N 33/68 (2006.01)A61K 31/724 (2006.01)A61K 31/765 (2006.01)A61K 47/48 (2006.01)A61K 51/06 (2006.01)A61K 51/12 (2006.01)C08G 83/00 (2006.01)A61K 47/54 (2017.01)
- (52) U.S. Cl.

CPC C08B 37/0015 (2013.01); A61K 31/724 (2013.01); A61K 31/765 (2013.01); A61K 47/48215 (2013.01); A61K 47/48969 (2013.01); A61K 51/065 (2013.01); A61K 51/1268 (2013.01); G01N 33/6893 (2013.01); A61K 47/547 (2017.08); C08G 83/007 (2013.01)

(58) Field of Classification Search

None

See application file for complete search history.

(56) References Cited

U.S. PATENT DOCUMENTS

6,068,831 A 5/2000 Platzek et al. 2013/0224881 A1 8/2013 Thompson et al.

FOREIGN PATENT DOCUMENTS

EP	3037097 A1	6/2016
WO	WO-9801163 A2	1/1998
WO	WO-2012124218 A1	9/2012
WO	WO-2014182804 A1	11/2014

OTHER PUBLICATIONS

"International Application Serial No. PCT/US2014/037134, International Preliminary Report on Patentability dated Nov. 19, 2015", 6 pgs.

Nakazono, Kazuko, et al., "High-Yield One-Pot Synthesis of Permethylated R-Cyclodextrin-based Polyrotaxane in Hydrocarbon Solvent through an Efficient Heterogeneous Reaction", *Macromolecules*, 43, (2010), 691-696.

"European Application Serial No. 14794124.9, Extended European Search Report dated Jan. 31, 2017", 19 pgs. Bryson, Joshua M, et al., "A beta-cyclodextrin Click Cluster deco-

Bryson, Joshua M, et al., "A beta-cyclodextrin Click Cluster decorated with seven paramagnetic chelates containing two water exchange sites", Bioconjugate Chemistry, Acs, Washington, DC, US, vol. 19, No. 8, (Aug. 1, 2008), 1505-1509.

Chuan, Yang, et al., "Thermoresponsive Behavior of Cationic Polyrotaxane Composed of Multiple Pentaethylenehexamine-grafted [alpha]-Cyclodextrins Threaded on Polyropylene oxide)-Poly(ethylene oxide)-Poly(propylene oxide) Triblock Copolymer", Journal Of Physical Chemistry Part B: Condensed Matter, Materials, Surfaces, Interfaces & Biophysical, vol. 113, (Jan. 22, 2009), 682-690.

Cristin, Davidson D, et al., "Chronic Cyclodextrin Treatment of Murine Niemann-Pick C Disease Ameliorates Neuronal Cholesterol and Glycosphingolipid Storage and Disease Progression", PLOS ONE, vol. 4, No. 9, (Sep. 11, 2009), 6951 pgs (15 pgs total).

Lee, et al., "Synthesis of main chain type polyrotaxanes by new click polymerization", Macromolecules, vol. 43, No. 9, (Jan. 1, 2010), 4070-4080.

Rosenbaum, A, et al., "Endocytosis of beta-cyclodextrins is responsible for cholesterol reduction in Niemann-Pick type C mutant cells", Proceedings Of The National Academy of Sciences, vol. 107, No. 12, (Mar. 23, 2010), 5477-5482.

Shuo, Li, et al., "Polyrotaxane-based triblock copolymers synthesized via ATRP of isopropylacrylamide initiated from the terminals of polypseudorotaxane of Br end-capped pluronic 17R4 and i-cyclodextrins", Science China Chemistry, Sp Science China Press, Heidelberg, vol. 55, No. 6, (May 8, 2012), 1115-1124.

Song, Y, et al., "Synthesis of multimeric MR contrast agents for cellular imaging", Journal of the American Chemical Society, American Chemical Society, US, vol. 130, No. 21, (May 28, 2008), 6662-6663.

(Continued)

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(57) ABSTRACT

Various embodiments of the present invention are directed to polyrotaxanes comprising a poloxamer core and at least one cyclodextrin and methods for treating Niemann-Pick type C (NPC) and imaging (e.g., MRI) using the polyrotaxanes various embodiments of the present invention.

10 Claims, No Drawings